SPACE MAGNETS ATTRACT INTEREST ON EARTH

Why is it important?

The familiar growth of plants—stems up, roots, down—is controlled by several mechanisms that we do not fully understand. We know that gravity is a primary controller, but we are uncertain how this is sensed and used within plants.

What is NASA doing?

Plant growth under low-gravity conditions in space has a been a keystone of fundamental space biology research. Current research indicates that the position of subcellular starch grains (amyloplasts) in plant cells plays a major role in a plant's sense of up and down. On Earth, amyloplasts in plant cells accumulate in the direction of gravity, causing a change in the cell's growth.

Amyloplasts can be moved by strong magnetic fields. Thus, a high-gradient magnetic field (i.e., concentrated at a specific point) could provide an artificial sense of "up" and "down" (not artificial gravity). As the root grows, the starch grains should be repelled by the magnetic gradient, causing the roots to curve in the direction of the displaced starch grains.

What are the benefits?

The BioTube/Magnetic Field Apparatus experiment addresses three major questions:

- Are amyloplasts (the starch grains) the organelles in plant cells that perceive gravity?
- Does the position or movement of the amyloplasts (caused by sedimentation on Earth or response to a high-gradient magnetic field in orbit) affect the root growth direction?
- Does gravity exert an effect on the deposition of cell wall material and the organization of plant cell organelles?

What is next?

The BioTube/Magnetic Field Apparatus investigation on the STS-107 research mission in 2003 will germinate and grow dry flax seeds in magnetic fields for 48 hours, then fix them for postflight analysis. As with all basic research, this study will contribute to an improved understanding of how plants grow and will have implications for improving plant growth and productivity on Earth. Similar flight experiments could be conducted on the ISS to increase our knowledge of how biological processes are affected by microgravity.

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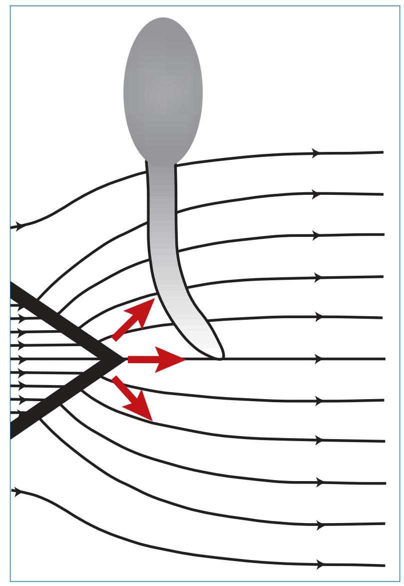

The tip of a wedge-shaped magnet will produce a strong magnetic gradient. Amyloplasts in the root tips should move away from the wedge edge, causing the root tips to curve (above). In simulated low-g, amyloplasts are randomly distributed (below, left), but displaced to one side when a magnetic field is applied (below right).